Credit and Debt-Deflation[1]

We now turn our attention to the interaction of of macroeconomics and financial markets. It is clear that shocks to financial markets such as asset pricing bubbles (*e.g.* to housing or stocks) are responsible for many economic downturns. Examples include the recent recession, which is closely linked to a historic housing bubble, the recession of 2001, closely linked to a technology stock bubble, and the Great Depression, closely linked to the collapse of the banking sector. Our purpose is to formalize these shocks into a model.

The Supply Side

The supply side of the economy is represented by a New Keynesian Phillips Curve:

$$\pi_t = \pi^e_{t+1} + \bar{v}\tilde{Y}_t + u_t \tag{1}$$

This is the same equation that we obtained earlier in the class. Note that I have not used the assumption that $\pi^e_{t+1} = \pi_{t-1}$.

The Demand Side

The demand side of the economy is represented by an Euler Equation:

$$\tilde{Y}_t = \tilde{Y}^e_{t+1} - \bar{b}(i_t - \pi^e_{t+1}) + g_t \tag{2}$$

Once again, this equation was also derived earlier in the term. I have, however, imposed that $\bar{r} = 0$. We can now, however, add some additional structure to the demand shock, g_t. Recall our model of asset markets. This model did not predict the actual asset price. Instead it predicted the asset's fundamental value. When an asset's price does not equal its fundamental value, a speculative bubble exists. Define the price of an asset (q_t) as the sum of the fundamental part and the bubble component:

$$q_t = q^f_t + q^b_t \tag{3}$$

Providing good microeconomic foundations (profit and utility maximization) for speculative bubbles is among the most challenging tasks in macroeconomics. So we will trade microfoundations for simplicity by assuming that q^b_t is exogenous.

[1]These are undergraduate lecture notes. They do not represent academic work. Expect typos, sloppy formatting, and occasional (possibly stupefying) errors.

Suppose that q_t^b decreases, which we may interpret as the bursting of an asset bubble:

i. Using the Life Cycle Model, households experience a decline in their lifetime wealth. They thus rationally choose to reduce their consumption.

ii. The reduction in consumption (and subsequently output) may decrease current and future firm profits. The fundamental value of stocks may then fall. Likewise, housing demand may decrease, reducing the fundamental value of housing. This amplifies the impact of the bursting of the bubble.

Collectively, i and ii imply that shocks to q_t^b are included in g_t. This demand term thus includes speculative bubbles.

Monetary Policy

We continue to assume that the Central Bank sets a target inflation rate, $\bar{\pi}$. In the United States, for example, this target is 2%. The Central Bank then tries to set interest rates using the following policy rule:

$$i_t = \bar{\pi} + \phi_1 \tilde{Y}_t + \phi_2(\pi_t - \bar{\pi}) \tag{4}$$

By assuming that $\phi_1, \phi_2 > 0$, the Fed lowers interest rates in response to depressed output or lower inflation.

Solving the Model

Dealing with the expectational terms continues to make solving the model under rational expectations beyond the scope of this class. So we will rely on the following heroic assumptions. Note that they are a little different than earlier in the class.

$$\tilde{Y}_{t+1}^e = 0 \tag{5}$$

$$\pi_t^e = \bar{\pi} \tag{6}$$

We are thus assuming that agents always expect output to go back to potential output in the next period and inflation to go back to its target. Agents are thus naive. This is not ideal. But it does allow us to illustrate the model's most important points without making the model too complex.

Inserting (4)-(6) into (1) and (2) and rearranging yields:

$$\pi_t = \bar{\pi} + \bar{v}\tilde{Y}_t + u_t \tag{7}$$

$$\pi_t = \bar{\pi} - \frac{\bar{b}^{-1} + \phi_1}{\phi_2}\tilde{Y}_t + \frac{\bar{b}^{-1} g_t}{\phi_2} \tag{8}$$

If we define the former equation as aggregate supply and the latter as aggregate supply, then we can plot the model in inflation/output gap space:

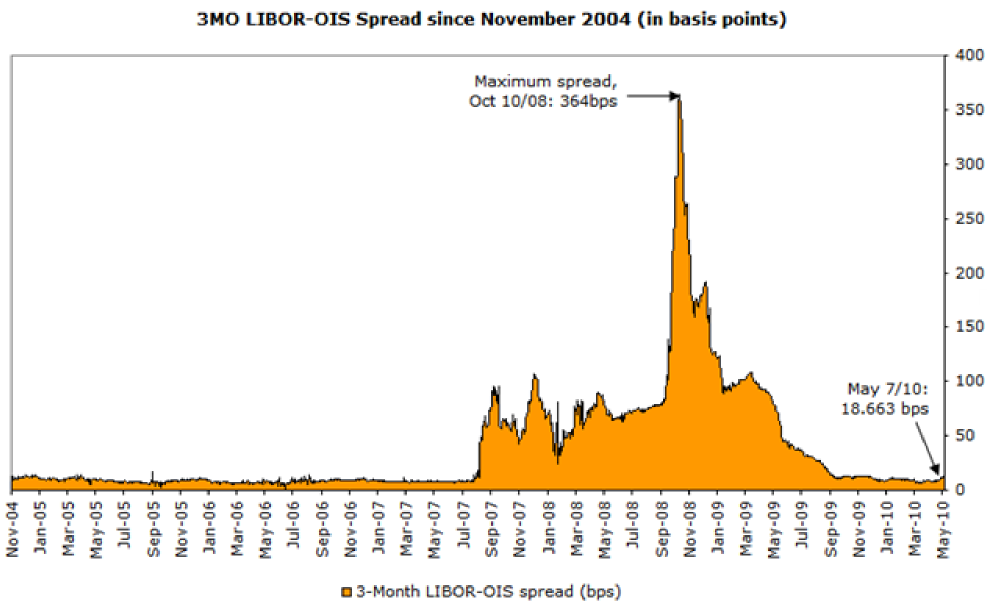
Graph: Equilibrium in NK model

Notice that if $g_t = u_t = 0$, then equilibrium occurs where $\tilde{Y}_t = 0$, and $\pi_t = \bar{\pi}$. Supply shocks where $u_t > 0$ increase inflation and reduce output. Demand shocks where $g_t > 0$ increase both inflation and the output gap.

The model as it currently stands is thus very similar to the version from earlier in the term. It does not tell us much about financial crises. To allow it to do so, we will add credit spreads into the model.

Credit Spreads

So far, we have assumed that agents can borrow at the risk free interest rate. in reality, however, lenders must pay a credit spread (also known as a risk premium) on top of the risk free interest rate. The data show that, most of the time, these are fairly small (about 0.1%). So our model, as it currently stands, is acceptable for most macroeconomic conditions. During financial crises, however, credit spreads may become very important and much larger. The following data show this. Credit spreads (as measured by the difference between LIBOR, a risky rate, and OIS, a fairly riskfree rate) through the Summer of 2007 were very low. During the recent financial crisis, however, they increased dramatically, reaching 3.64% in October 2008.[2]



We thus assume that lenders borrow at the rate $i_t + cs_t$. The credit spread is determined by:

$$cs_t = \left\{ \begin{array}{lll} 0 & if & \pi_t + \omega_1 \tilde{y}_t - \omega_2 i_t \geq \bar{c} \\ \tau & if & \pi_t + \omega_1 \tilde{y}_t - \omega_2 i_t < \bar{c} \end{array} \right\}$$

where $\tau > 0$, and $\omega_1, \omega_2 > 0$. We are thus assuming that three factors result in potentially significant credit spreads:

1. Deflationary pressures. Most debt in the United States is tied to fixed interest rates that do not automatically adjust for inflation. Suppose that a potential borrower has an existing level of debt. When deflation occurs, the real value of their outstanding debt decreases. They thus become less likely to make their payments and the chances of default increase. Lenders thus demand a higher credit spread to compensate them for this heightened risk.

2. Lower output. As income declines and unemployment increases, default risk also increases.

3. Higher (risk free) interest rates. As i_t increases, so do the associated finance charges and the risk of default.

Many macroeconomists believe that deflation is the most important of these three factors. *Debt-Deflation* is the cycle where reduced demand lowers prices, which increase real debt burdens, which

[2]Taken from William R. Horton, Jr., writing for *MD Physician Services*, 5/7/10.

increase credit spreads and reduce aggregate demand. This reduced demand further lowers prices and the cycle repeats itself. Debt-deflation remains the best explanation for the severity of the Great Depression where cumulative deflation peaked at about 33%. Ben Bernanke has written extensively on the Great Depression and has clearly been quite concerned about a repeat of debt-deflation during the current downtown.

This assumption also illustrates the *credit channel* of monetary policy which is especially important during financial crises. By lowering i_t, a Central Bank is able to apply downward pressure on credit spreads.

If the economy is in a financial crisis, then aggregate demand may be rewritten as:

$$\pi_t = \bar{\pi} - \frac{\bar{b}^{-1} + \phi_1}{\phi_2}\tilde{y}_t + \frac{\bar{b}^{-1} g_t - \tau}{\phi_2} \tag{9}$$

A Demand Induced Crisis

Consider the following example. An asset pricing bubble bursts. This is represented in our model as a negative value of g_t. This reduces aggregate demand.

In our graph, the region of crisis lies at the lower left of the space. If the shock to demand is large enough, then it may push the model into this region changing the nature of aggregate demand from (6) to (9). Large credit spreads kick in resulting in a larger reduction of output and inflation than occurs in the model without credit effects. The effects of the demand shock are thus *amplified*.

Graph: Equilibrium in NK model, with Credit Effects

Liquidity Traps

There is one additional complication that makes the situation worse still. So far, we have assumed that i_t is unbounded from below. In reality, however, nominal interest rates must be positive. In our example, inflation and the output gap are especially low. It is thus possible (as is currently the case) that (4) suggests that $i_t < 0$. This is known as a *liquidity trap*. If this occurs, we can further modify our aggregate demand equation by imposing that $i_t = 0$. This yields a third aggregate demand equation:

$$\tilde{Y}_t = -\bar{b}(\tau - \bar{\pi}) \tag{10}$$

Plotting this scenario:

Graph: Equilibrium in NK model, Liquidity Trap

The liquidity trap limits the Central Bank's ability to respond to the financial crisis through conventional monetary policy. The reduction in output and potential deflation are thus made worse still.

Conclusions

This model is obviously not intended to capture every aspect of financial crises. But I hope that it does yield insight into how imperfect financial (credit) markets can lead to a cycle where negative shocks are amplified. It also illustrates issues that we will encounter later in the course:

The Central Bank's job becomes much more complicated than simply lowering short term interest rates in response to the downturn. First, it must worry about how macroeconomic variables, especially deflation, can lead to a tightening of private credit in the economy. Second, once i_t nears zero, it must come up non-conventional ways to stabilize the economy. Both of these complications are important to understanding why policy makers have recently resorted to non-conventional monetary policies such as TARP, and quantitative easing.